TechDataSheet

Naval Facilities Engineering Service Center
Port Hueneme, California 93043-4370

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Solar Preheated Ventilation

Innovative Solar Technology

Introduction

Many military and industrial installations such as shops, garages, hangers, offices, and residential buildings face the problem of heating ventilation air during the cold season. Solar Walls are efficient, reliable, zero maintenance, solar air preheaters that offer many opportunities for Navy facilities to save money on their annual energy bill. This innovative technology applies to both new construction or rehabilitation projects. This TDS introduces this low maintenance solar technology for consideration in all future industrial ventilation or HVAC projects.

Solar Preheating Technologies

Preheating saves energy. Currently, two preheating alternatives exist: heat recovery wheels and solar wall preheaters. During the heating season, cold outdoor ventilation air must be heated to maintain comfort. In the northern half of the country, if occupancy is mainly during the daylight hours, the solar wall preheater is the most economical because it requires no maintenance. The only moving part is the existing ventilation fan. Payback is three years in the sunny, cool regions of the U.S. Other U.S. regions may require as much as ten years.

Solar Wall Technical Description

The solar wall consists of dark metal siding with small holes set off a few inches from the south wall of the building. The siding is sealed at its edges so that a fan can withdraw heated air from the space between the siding and the wall. The heated layer of outside air touching the solar wall is drawn through the small holes into the space behind the siding. Once inside this space, the air is further heated because of continued contact with the hot siding. A 40°F air temperature rise is typical. A fan, usually near the top of the solar wall, draws the warmed air from this space and distributes it through the space to be ventilated. Frequently it is distributed through inflated fabric ducts with holes in the side that emit the warmed air into the hot stratified air trapped near the ceiling of the building, causing circulation of the warmed air, a beneficial destratification effect.

In a combined effort, the solar wall concept was recently developed by a Canadian company with U.S. offices, Conserval Systems, Inc., and personnel at the National Renewable Energy Laboratory (NREL) in Golden, Colorado. Extensive research into optimizing the performance of the concept and the development of design criteria and procedures were conducted at both NREL and Conserval.

Applicability

Examples of typical installations of this technology are shown in the following application photographs.

Figure 1. A close-up of the perforated metal siding of the Steeltech machine shop in South Windsor, Connecticut, showing the spacing of the 1/16th-inch holes. In this shop area, metal fabrication operations including welding, abrasive metal cutting, grinding, sanding, and painting (all of which have specific ventilation requirements for makeup air) are performed.

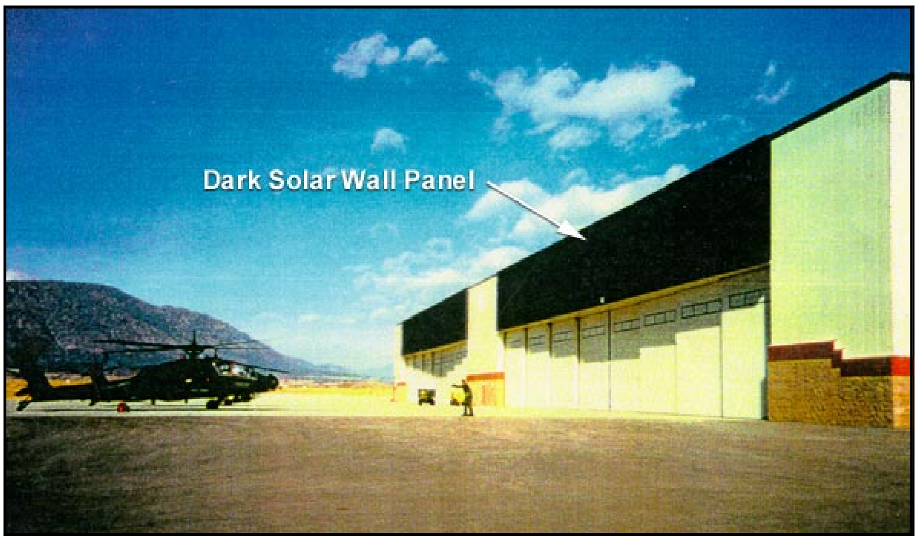

Figure 2. Exterior view of the dark brown solar wall panels above the hanger doors on the helicopter hanger at Fort Carson in Colorado Springs, Colorado.

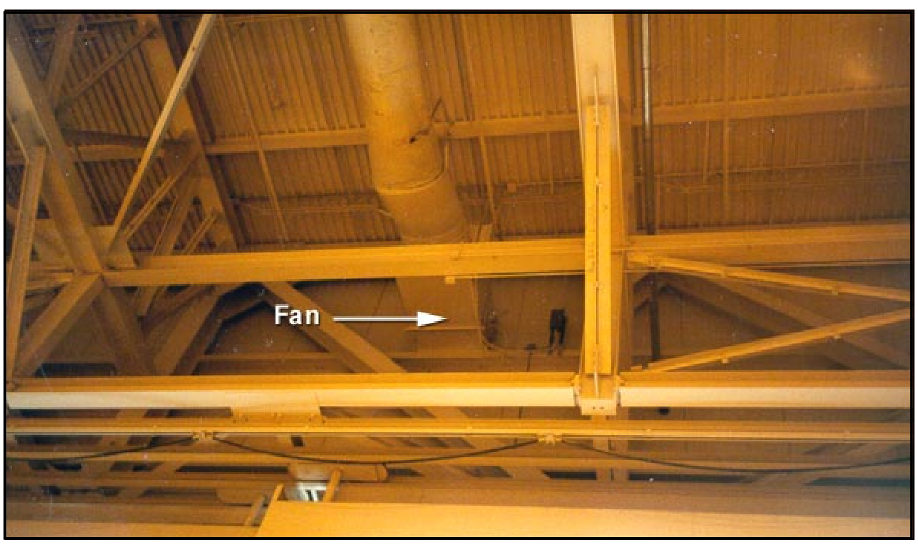

Figure 3. Interior view of the helicopter hanger at Fort Carson, Colorado Springs, shows one of the ventilating fans that distribute the preheated air in fabric ducts.

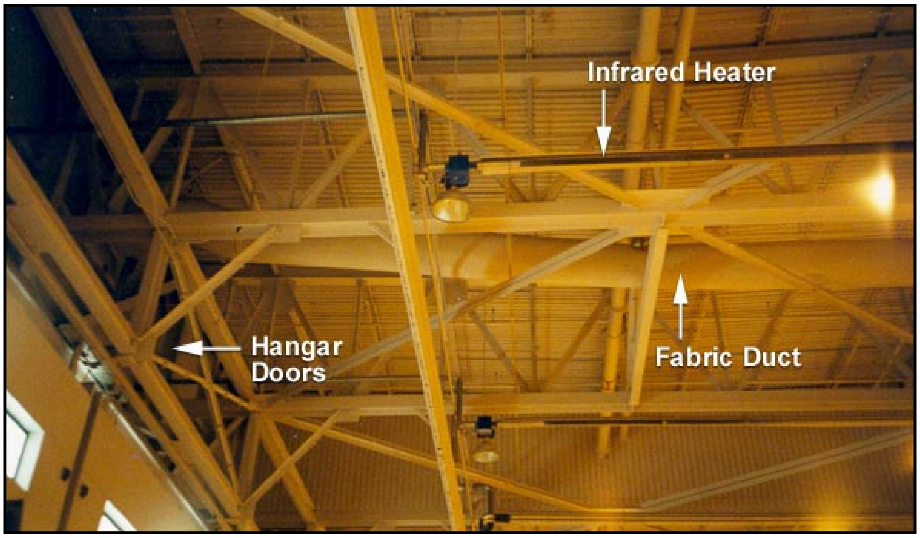

Figure 4. Further detail of the interior helicopter hanger at Fort Carson, Colorado Springs, showing the duct and gas-fired infrared heaters which are the main heat source. Three strips of the heaters are visible. The solar wall has provided preheated ventilation to improve indoor air quality with no increase in energy costs.

Figure 5. The black solar wall on the Steeltech machine shop in South Windsor, Connecticut.

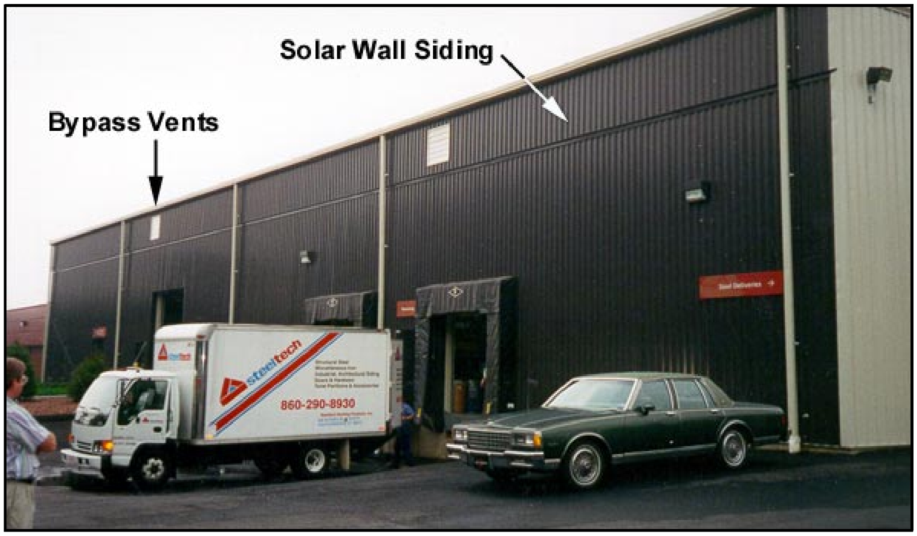

Figure 6. Additional view of the black solar wall on the Steeltech machine shop in South Windsor, Connecticut.

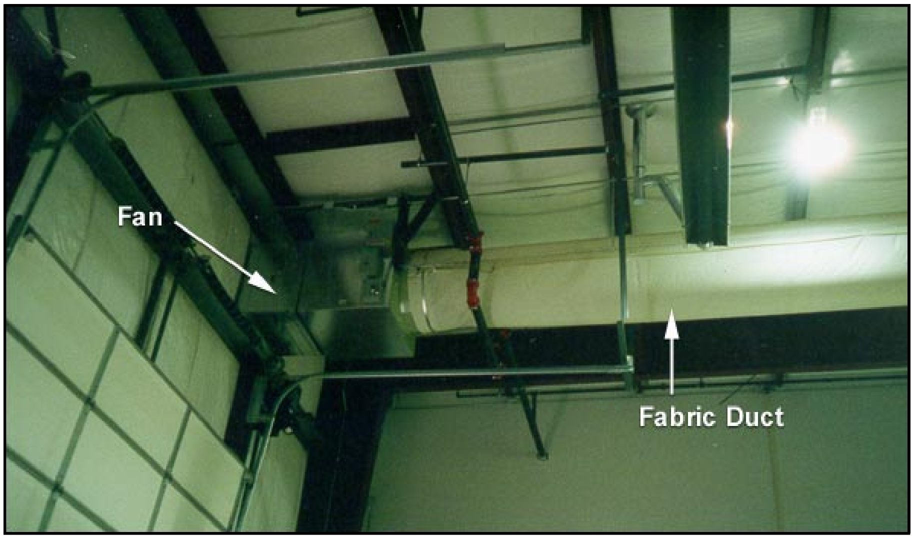

Figure 7. One of the vent fans in the Steeltech machine shop in South Windsor, Connecticut, drawing in preheated air from behind the solar wall and distributing it in a fabric duct through the building.

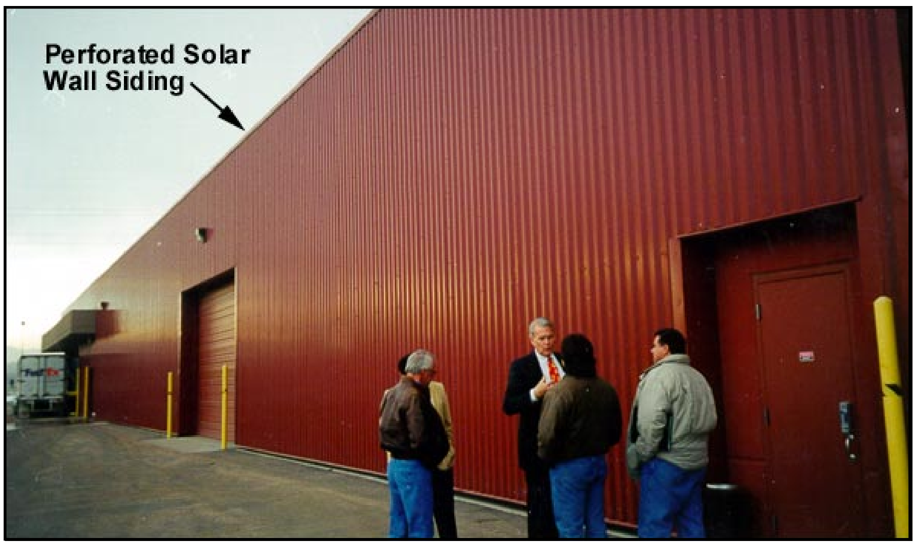

Figure 8. The dark red solar wall on the Federal Express Distribution Center in Denver, Colorado.

Figure 9. Interior of the Federal Express Distribution Center building in Denver, Colorado. Fabric ducts with 2-inch holes at 10 o'clock and 2 o'clock from which the preheated ventilation air is distributed are shown. 90,000 cubic feet per minute of ventilation air is required to counter the carbon monoxide and other pollutants from the 80 gasoline-powered Federal Express trucks that enter and exit twice each day.

Figure 10. A black 350-square foot solar wall on a chemical waste handling building at NREL in Denver, Colorado. This building must be completely ventilated prior to each human entry. The vent in the center bypasses the solar wall in summer. Solar heat is an excellent application for this building because an open flame cannot be used due to explosive chemicals.

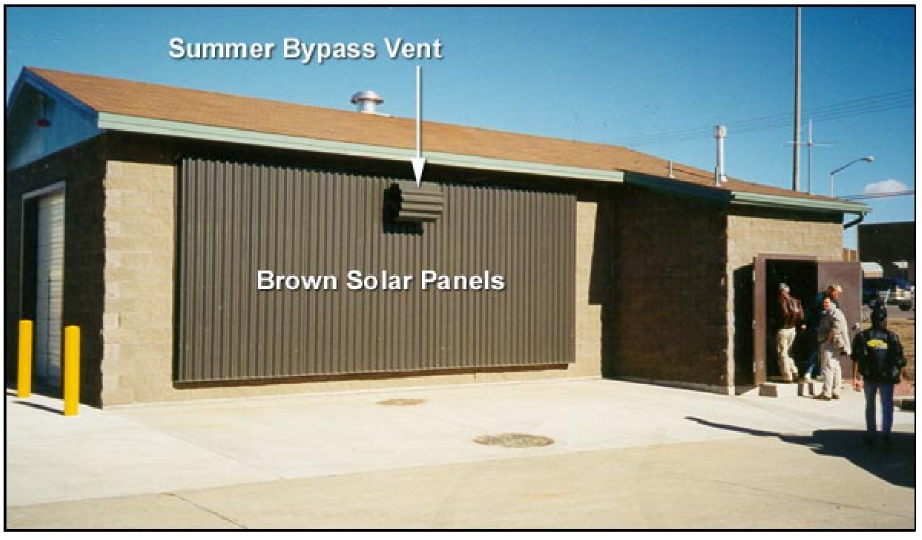

Figure 11. A brown 300-square foot solar wall on the Battery Storage facility at Fort Carson in Colorado Springs. The panels were purchased from the patent holding manufacturer, Conserval, and with the help of NREL, the Public Works Department at Fort Carson designed and installed the system themselves. Solar preheat provided a non-open flame-heated ventilation system in a potentially explosive environment. Electric resistance heat is the supplemental heat source.

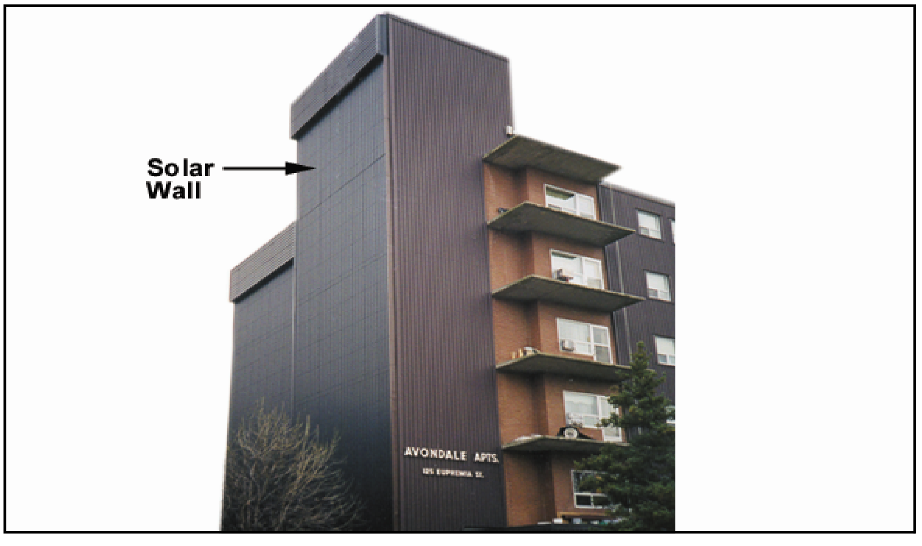

Figure 12. A six-story solar wall on the Avondale Apartments in Sarnia, Ontario. Warm air is drawn off at the top and is further heated by a radiator and distributed to the hallways of the building. Many apartment buildings in Canada are using solar wall preheaters. One such senior housing apartment building in Windsor is 25 stories high with a 15-foot wide solar wall panel rising the full height.

Figure 13. A 1,270-square foot solar wall on the penthouse of the main industrial facility of Aveda Corporation just north of Minneapolis, Minnesota. This preheated air is ducted into the existing makeup air heating system and is bypassed in the summer when it is not needed. The PC-based energy management system monitors the temperature twice a minute, and on sunny, cold Minnesota days, the solar wall is providing a 35 to 40 degree preheat of the makeup air.

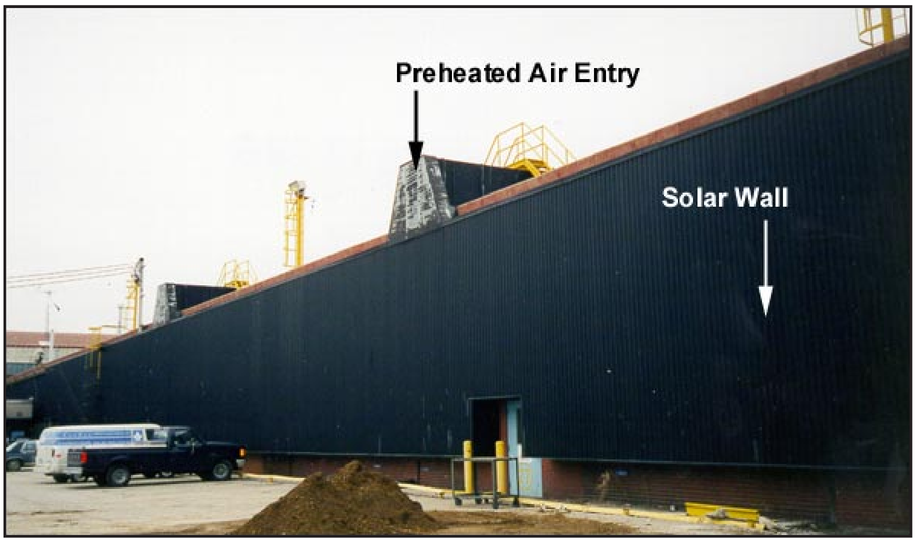

Figure 14. A huge 10,500-square foot solar wall on the Ford Ensite Engine plant in Windsor, Ontario. The original wall was unattractive, required insulation, and was in need of recladding prior to the solar wall installation, which improved the economics of the installation. This is one of eight solar wall installations on Ford Motor Company plants in the United States and Canada.

The accompanying DOE Federal Technology Alert on Transpired Solar Collectors included in this TechData Sheet provides an additional description of the technology and the design calculation procedure. An example life cycle cost calculation is also given in the appendix. Maps on page 12 show the areas of the country where the payoff is the greatest. Most projects in the gray areas of the map will pay back in 10 years or less, depending on the local cost of fuel displaced. In many situations where the building is in need of recladding and fuel costs are high, payback could be as few as three years.

Solar Wall projects are included in the President's *Million Solar Roofs Initiative*. Twenty thousand solar modifications are to be on federal buildings by 2010; thus, implementation of this technology is strongly encouraged. The status of the Initiative can be reviewed at **http://www.eren.doe.gov./millionroofs**. Federal Energy Management Program (FEMP) support can be expected for suitable projects.

Further information may be obtained from these Navy contacts at the Naval Facilities Engineering Service Center:

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